

Lesson: Wet Maps (MS)

Next Generation Science Standards Performance Expectations

MS-PS4 Waves and Their Applications in Technologies for Information Transfer

Performance Expectations:

MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. [Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.] [Assessment Boundary: Assessment is limited to qualitative applications pertaining to light and mechanical waves.]

Science and Engineering Practices:

Developing and Using Models

- Develop and use a model to describe phenomena. (MS-PS4-2)

Disciplinary Core Ideas:

PS4.A: Wave Properties

- A sound wave needs a medium through which it is transmitted. (MS-PS4-2)

Crosscutting Concepts:

Structure and Function

- Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (MS-PS4-2)

Common Core State Standards Connections:

ELA/Literacy –

SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-PS4-1),(MS-PS4-2)

Mathematics –

MP.2 Reason abstractly and quantitatively. (MS-PS4-1)

MP.4 Model with mathematics. (MS-PS4-1)

Additional Science and Engineering Practices:

Asking Questions and Defining Problems

- Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
- Ask questions to identify and/or clarify evidence and/or the premise(s) of an argument.
- Ask questions to clarify and/or refine a model, an explanation, or an engineering problem.

Developing and Using Models

- Evaluate limitations of a model for a proposed object or tool.

Analyzing and Interpreting Data

- Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships.
- Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships.
- Analyze and interpret data to provide evidence for phenomena.

Additional Crosscutting Concepts:

Patterns

- Graphs, charts and images can be used to identify patterns in data.

Systems and System Models

- Models can be used to represent systems and their interactions.
- Models are limited in that they only represent certain aspects of the system under study.

Lesson: Mapping the Deep-ocean Floor (MS)

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Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World

- Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations.

Connections to Nature of Science

Science is a Human Endeavor

- Advances in technology influence the progress of science and science has influenced advances in technology.

Common Core State Standards Connections:

ELA/Literacy –

SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-PS4-1),(MS-PS4-2)

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Lesson: Watching in 3D (HS)

Next Generation Science Standards Performance Expectations

HS-PS4 Waves and Their Applications in Technologies for Information Transfer

Performance Expectations:

HS-PS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. [Clarification Statement: Examples of data could include electromagnetic radiation traveling in a vacuum and glass, sound waves traveling through air and water, and seismic waves traveling through the Earth.] [Assessment Boundary: Assessment is limited to algebraic relationships and describing those relationships qualitatively.]

Science and Engineering Practices:

Using Mathematics and Computational Thinking

- Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations. (HS-PS4-1)

Disciplinary Core Ideas:

PS4.A: Wave Properties

- The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. (HS-PS4-1)

Crosscutting Concepts:

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS4-1)

HS-PS4-5. Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.* [Clarification Statement: Examples could include solar cells capturing light and converting it to electricity; medical imaging; and communications technology.] [Assessment Boundary: Assessments are limited to qualitative information. Assessments do not include band theory.]

Science and Engineering Practices:

Obtaining, Evaluating, and Communicating Information

- Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-PS4-5)

Disciplinary Core Ideas:

PS4.A: Wave Properties

- Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. (HS-PS4-2),(HS-PS4-5)

PS4.C: Information Technologies and Instrumentation

- Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them. (HS-PS4-5)

Crosscutting Concepts:

Cause and Effect

- Systems can be designed to cause a desired effect. (HS-PS4-5)
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Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World

- Modern civilization depends on major technological systems. (HS-PS4-2),(HS-PS4-5)

Common Core State Standards Connections

Mathematics –

MP.2 Reason abstractly and quantitatively. (HS-PS4-1),(HS-PS4-3)

MP.4 Model with mathematics. (HS-PS4-1)

Additional Science and Engineering Practices:

Asking Questions and Defining Problems

- Ask questions that arise from examining models or a theory, to clarify and/or seek additional information and relationships.

Analyzing and Interpreting Data

- Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.

Using Mathematical and Computational Thinking

- Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.
- Apply techniques of algebra and functions to represent and solve scientific and engineering problems.

Additional Crosscutting Concepts:

Patterns

- Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

Cause and Effect

- Systems can be designed to cause a desired effect.

Systems and System Models

- Systems can be designed to do specific tasks.
- When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.
- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.
- Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.

Connections to Engineering, Technology, and Applications of Science

Influence of Engineering, Technology, and Science on Society and the Natural World

- Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.

MIDDLE SCHOOL NGSS ALIGNMENTS

MS-PS4 Waves and Their Applications in Technologies for Information Transfer

Performance Expectations:

MS-PS4-3. Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals. [Clarification Statement: Emphasis is on a basic understanding that waves can be used for communication purposes. Examples could include using fiber optic cable to transmit light pulses, radio wave pulses in wifi devices, and conversion of stored binary patterns to make sound or text on a computer screen.] [Assessment Boundary: Assessment does not include binary counting. Assessment does not include the specific mechanism of any given device.]

Science and Engineering Practices:

Obtaining, Evaluating, and Communicating Information

- Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims and findings. (MS-PS4-3)

Disciplinary Core Idea:

PS4.C: Information Technologies and Instrumentation

- Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. (MS-PS4-3)

Crosscutting Concepts:

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World

- Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations. (MS-PS4-3)

Connections to Nature of Science

Science is a Human Endeavor

- Advances in technology influence the progress of science and science has influenced advances in technology. (MS-PS4-3)

Note: Additional Science and Engineering Practices and Crosscutting Concepts to target will be dependent on the content of the live feed and the direction educators choose to take with this lesson.

Common Core State Standards Connections:

ELA/Literacy –

RST.6-8.2 Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (MS-PS4-3)

RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-PS4-3)

HIGH SCHOOL NGSS ALIGNMENTS

HS-PS4 Waves and Their Applications in Technologies for Information Transfer

Performance Expectations:

HS-PS4-2. Evaluate questions about the advantages of using a digital transmission and storage of information. [Clarification Statement: Examples of advantages could include that digital information is stable because it can be stored reliably in computer memory, transferred easily, and copied and shared rapidly. Disadvantages could include issues of easy deletion, security, and theft.]

Science and Engineering Practices:

Asking Questions and Defining Problems

- Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. (HS-PS4-2)

Disciplinary Core Idea:

PS4.A: Wave Properties

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Crosscutting Concepts:

Connections to Engineering, Technology, and Applications of Science

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- Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. (HS-PS4-2)

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Common Core State Standards Connections:

ELA/Literacy –

RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author’s claim or a recommendation for solving a scientific or technical problem. (HS-PS4-2),(HS-PS4-3),(HS-PS4-4)

RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-PS4-2),(HS-PS4-3),(HS-PS4-4)

RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-PS4-1),(HS-PS4-4)